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STOOL ANALYSIS IN PANCREATIC FIBROSIS & CELIAC DISEASE

WILLIAM D. BEVIS

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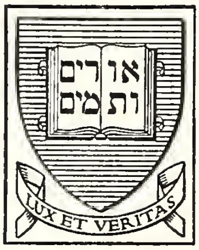

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STOOL ANALYSIS IN PANCREATIC FIBROSIS AND CELIAC DISEASE

William D. Bevis

Columbia University 1943-1945

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Department of Pediatrics
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INTRODUCTION

Stool studies are part of the routine diagnostic procedure on children with steatorrhea and evidence of abnormal nitrogen absorption. Steatorrhea is the general name applied to disorders characterized by excessive loss of fat in the stools.

High stool fat is met: (1) in acute diarrheal disorders where there may be an excessive loss of fat and also nitrogen in the stool, but this condition is temporary and can be followed by serial stool studies; (2) following a prolonged, one-sided diet, diagnosed from the dietary history and amenable to dietary treatment; (3) in obstruction of the mesenteric lymphatics, a diagnosis usually made by exclusion of other causes (1); (4) in acholic steatorrhea, usually not a diagnostic problem because of the presence of jaundice and the stool color; (5) in regional disease of the intestine, but the X-ray picture is usually sufficient to make the differential diagnosis; (6) in pancreatic insufficiency, but the disease is also associated with a defective absorption of nitrogen and absence of pancreatic enzyme; (7) in idiopathic steatorrhea (celiac disease)not associated with

grossly defective nitrogen absorption or absence of pancreatic enzyme. This paper will limit itself to a discussion of the latter two diseases.

Analysis for presence or absence of pancreatic enzyme activity is of importance in making the differential diagnosis between celiac disease and pancreatic fibrosis.

Andersen (2,3) outlines a method of assaying trypsin based on procedures described by Fermi (4) and modified by Palitzsch and Walbum (5) whereby a #12 french catheter is used to aspirate duodenal joice, the location of the tip being checked by fluoroscopic examination. This method is of high reliability once the specimen for analysis is obtained, but the difficulties involved in aspiration are many and great, and frequently the attempt must be abandoned.

A much simpler qualitative assay for presence of trypsin has been devised by Farber (6) requiring an emulsion of stool in 5% Na_2CO_3 and a small piece of exposed but undeveloped X-ray film. The stool sample may be up to twenty-four hours old, but a fresh specimen is preferable. Serial dilutions of the emulsion may be made, but this is not done routinely. The gelatin coat is washed from one side of the X-ray film with warm tap water, and a drop

of stool emulsion is placed alongside a drop of 5% Na_2CO_3 as a control on the other side, incubated for one hour at 37°C, and then the film is rinsed in cold tap water. Holding the film to the light will disclose clear areas of gelatin digestion if the trypsin is present. In the case of small infants a clear area definitely shows presence of trypsin, but a negative test does not necessarily rule out the presence of the enzyme. From the age of roughly two to four years, however, the reverse is true, i.e. no digestion definitely means absence of trypsin activity whereas a positive test does not necessarily mean presence of pancreatic enzyme, for by this age intestinal proteoses have begun to appear.

OBJECTIVE

Parmelee (7) has said, " It is our feeling that a careful total and differential analysis of the stool fat should be carried out in all cases of steatorrhea as a means of differentiating between pancreatic and non-pancreatic type (celiac disease)". The literature frequently recommends examination of stool for percentage fat in total dried weight. This paper proposes to test whether this method of calculation gives results compatible with the final diagnosis and to illustrate how fat and nitrogen values can give more effective information when the percentages are based on the

amount of fat and nitrogen ingested in making the differential diagnosis between no significant steatorrhea, pancreatic, and celiac cases.

DISCUSSION

A review of the laboratory data on three day stool studies done by the Department of Pediatrics of the New Haven Hospital during the period of 1945-1949 shows that percentage fat and nitrogen excretion figures lead to confusion when calculated in total dried weight of the specimens.

The laboratory routine at the New Haven Hospital is the determination of the total dried weight of the specimen, the total fat, and the total nitrogen values. These figures plus analysis of duodenal juice or stool emulsion for trypsin activity, X-ray of the chest and gastro-intestinal tract, and careful evaluation of the total clinical picture, history, and physical findings have given sufficent bases for making a differential diagnosis between celiac diseases and pancreatic fibrosis.

When a three day stool study is indicated, the patient is put on a normal diet including one initial small amount of

carmen red. Stools are collected with the first specimen showing the dye and are carefully saved until the second sign of the carmen red (fed seventy-two hours after the first) appears. This last stool is then discarded. An effort to save all the stool produced during the intervening time is made, and when necessary, the stool is scraped from the diaper with a rubber spatula. The stools under collection are saved in a glass container. In the case of infants and especially of girls the stool may become contaminated with urine causing the total nitrogen in the stool to be misleadingly high. The infants are not placed on a metabolism frame so that the stools are separated from the urine. This procedure would not be feasible for girls. If the stools are firm or pasty, the urine is apparently soaked up by the diaper so that contamination with urine is small. Liquid stools, however, mix with the urine, and the nitrogen values are meaningless. A low stool nitrogen definitely indicates good absorption of nitrogen. A high stool nitrogen must be evaluated with due consideration given to the likelihood of urine nitrogen contaminating the stools. Since urine contains no fat, the analyses are valid for stool fat.

In steatorrhea the stool fat is related to the intake, being higher the greater the fat intake. For this reason stool

analyses require that the intake be fairly high in order to bring out increased amounts of stool fat. Normal infants show no great increase in stool fat when the intake is increased (8).

During the three day collection period the dietary intake with amounts received, refused, and regurgitated is recorded so that the total fat and nitrogen intake of the patient can be roughly calculated. Even with the most careful attention of the busy nursing service, however, some errors are bound to occur, but the error is not thought to be more than plus or minus twenty percent. In some cases where intakes have failed to appear on charts the fat and nitrogen ingested have been estimated on the basis of the patient's diet and age.

FAT

The analyses expressed as percent fat in the dried stool are of little diagnostic aid in diagnosing steatorrhea. Table I shows that the normal infant may have the same amount of fat per 100 grams of dried stool as cases of pancreatic fibrosis or celiac disease.

TABLE I

°/o STOOL FAT / TOTAL DRIED WEIGHT

PANCREATIC FIBROSIS	CELIAC DISEASE	NORMAL(8)
35.0	20.7	42
37.5	25.5	
42	33.2	
46.4	33.7	
50	37.9	
61.5	43.2	
78	43.8	
	44	
	46	
	46	
	49.2	
	49.3	
	53.5	
	54	
	54.2	
	56.3	
	57.2	
	57.6	
	58.3	
	74.8	
	76.7	
	78	

When the percentage fat excretion is based on the amount of fat ingested, however, it becomes apparent that a greater difference is shown between normal, pancreatic fibrotic, and celiac stools, as brought out in Table II.

TABLE II

^{o}/o STOOL FAT / TOTAL FAT INTAKE

PANCREATIC FIBROSIS	CELIAC DISEASE	NORMAL (9)
22.5	3.9	15
27.9	6.4	
32.1	10.1	
45.1	13	
51.3	13.6	
54.5	14.1	
56.3	15.4	
	17.9	
	18.8	
	19	
	19	
	19.5	
	21	
	23	
	26	
	26.5	
	29.6	
	31.2	
	31.6	
	33.6	
	49.5	
	82.8	

A comparison of the two methods of calculation is made in Table III.

TABLE III

$$ {}^{c}/_{o}\ \frac{\text{STOOL FAT}}{\text{TOTAL DRIED WEIGHT}}\ \text{VS.}\ {}^{c}/_{o}\ \frac{\text{STOOL FAT}}{\text{TOTAL FAT INTAKE}} $$

PANCREATIC FIBROSIS		CELIAC DISEASE		NORMAL	
c/o $\frac{SF}{TDW}$	c/o $\frac{SF}{TFI}$	c/o $\frac{SF}{TDW}$	c/o $\frac{SF}{TFI}$	c/o $\frac{SF}{TDW}$	c/o $\frac{SF}{TFI}$
35.0	56.3	20.7	3.9	42	15
37.5	27.9	25.5	23		
42	32.1	33.2	13		
46.4	51.3	33.7	33.6		
50	45.1	37.9	19		
61.5	54.5	43.2	19		
78	22.5	43.8	19.5		
		44.0	26		
		46	15.4		
		46	29.6		
		49.2	31.2		
		49.3	13.6		
		53.5	17.9		
		54	26.5		
		54.2	21		
		56.3	14.1		
		57.2	31.6		
		57.6	18.8		
		58.3	49.5		
		74.8	6.4		
		76.7	10.1		
		78	82.8		

NITROGEN

Determination of nitrogen in the stool is of special importance. High nitrogen excretion is found in pancreatic fibrosis, whereas figures for celiac disease are either compatible with the normal or else only slightly elevated. Again, the analysis expressed as percent nitrogen in grams of dried stool does not differentiate cases of pancreatic fibrosis from celiac disease or the normal, as shown in Table IV.

TABLE IV

^{c}/o STOOL NITROGEN / TOTAL DRIED WEIGHT

PANCREATIC FIBROSIS	CELIAC DISEASE	NORMAL
5.5	3.2	7
5.5	3.6	
5.9	3.7	
7.7	3.9	
7.7	3.9	
8.6	4.2	
9.6	4.2	
	4.3	
	4.3 U	
	4.4	
	4.5	
	4.5	
	4.6	
	4.7	
	4.9	
	5.7	
	6.2	
	7.6 U	
	7.7	
	12.5	
	21	
	52.1 U	

U : CONTAMINATED WITH URINE

Reevaluation of the percentage nitrogen excretion on the basis of total nitrogen intake gives values more discrete than those found in similar fat analysis. The cases of high values in the celiac column marked "U" were noted on charts as contaminated with urine and so are misleadingly high. One or two celiac cases might have been falsely placed in the pancreatic fibrotic category had not the urine contamination been noted. Better notes on urine contamination would probably show few high nitrogens in the celiac group. Table V illustrates how percentage nitrogen excretion on the basis of total nitrogen intake can be of some worth in making the differential diagnosis between pancreatic and non-pancreatic steatorrhea. It will be noted that no proven case of pancreatic fibrosis had a normal stool nitrogen.

TABLE V

^{c}/0 STOOL NITROGEN / TOTAL NITROGEN INTAKE

PANCREATIC FIBROSIS	CELIAC DISEASE	NORMAL (10)
24.1	1.7	15
25.8	7.4	
30.2	7.6	
37.3	7.7	
39.8	7.8	
41.6	9	
42.6	9.7	
	10.2	
	10.3	
	11.6	
	12	
	13	

(Table continued)

TABLE V (Continued)

$^{c}/_{o}$ STOOL NITROGEN / TOTAL NITROGEN INTAKE

PANCREATIC FIBROSIS	CELIAC DISEASE	NORMAL (10)
	13.5	
	13.8	
	13.9	
	15.9	
	16.	
	16.4	
	22.7	
	23.3 U	
	39.6 U	
	41.7 U	

U : CONTAMINATED WITH URINE

A comparison of results obtained by the two methods of calculation is made in Table VI.

TABLE VI

$\% \frac{\text{STOOL NITROGEN}}{\text{TOTAL DRIED WEIGHT}}$ VS. $\% \frac{\text{STOOL NITROGEN}}{\text{TOTAL NITROGEN INTAKE}}$

PANCREATIC FIBROSIS		CELIAC DISEASE		NORMAL	
$\% \frac{SN}{TDW}$	$\% \frac{SN}{TNI}$	$\% \frac{SN}{TDW}$	$\% \frac{SN}{TNI}$	$\% \frac{SN}{TDW}$	$\% \frac{SN}{TNI}$
5.5	25.8	3.2	22.7	7	15
5.5	30.2	3.6	15.9		
5.9	41.6	3.7	13		
7.7	39.8	3.9	9		
7.7	37.3	3.9	7.6		
8.6	42.6	4.2	13.9		
9.6	24.1	4.2	1.7		
		4.3	10.2		
		U 4.3	23.3 U		
		4.4	9.7		
		4.5	12		
		4.5	7.4		
		4.6	16.4		
		4.7	13.5		
		4.9	7.8		
		5.7	11.6		
		6.2	7.7		
		U 7.6	41.7 U		
		7.7	16		
		12.5	10.3		
		21	13.8		
		U 52.1	39.6 U		

U : CONTAMINATED WITH URINE

SUMMARY

The importance of the clinical picture, the history, roentgenological findings, physical examination, and especially the analysis of duodenal drainings for trypsin activity cannot be overemphasized in making the differential diagnosis between celiac disease and pancreatic fibrosis. Stool studies for fat and nitrogen content are also important and may be helpful if the dietary intake is considered in the calculations of percentage excretion. Analysis on the basis of the total dried weight of the specimen has been shown to be of little diagnostic value. Even when rough estimates are made of the fat and nitrogen intakes in the absence of careful charting, values are obtained which are consistent in separating the two disease entities into comparatively discrete channels. Thus the value of the laboratory analysis of stools is enhanced.

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